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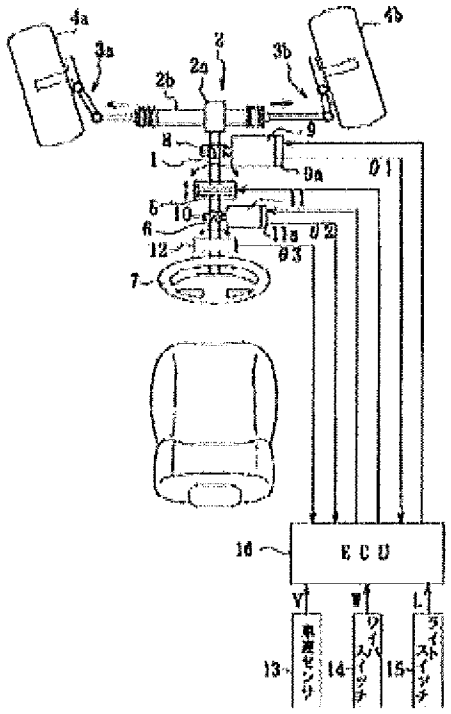
(54) STEERING DEVICE FOR VEHICLE

(57)Abstract:

PROBLEM TO BE SOLVED: To easily reduce the steering drift of a driver.

SOLUTION: The target steering angle θr of a rack pinion type steering wheel 2 is calculated, assuming that steering is smoothly performed and a first drive motor 9 is driven to obtain the target steering angle θr. The steering reaction as the characteristic of a steered quantity is determined, and a second drive motor 11 is drive to generate the steering reaction. When an ECU 16 detects the unstable state of a driving action, it changes at least one of the characteristic of the steering reaction, a first-order lead module and a first-order lag module, and a steering gain.



* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1]A steering amount detection means to detect a steering amount of a steersman stage, and a steering amount characteristic changing means which can change the characteristic of said steering amount, A transfer characteristic alteration means which can change the transfer characteristic of a transmission mechanism which transmits a steering amount of said steersman stage to a steering gear style, A steering quantity estimation means which presumes steering quantity of said steering gear style at the time of assuming that steering was performed smoothly based on said steering amount detected by steering quantity detection means to detect steering quantity of said steering gear style, and said steering amount detection means, Based on steering quantity presumed by steering quantity detected by said steering quantity detection means, and said steering quantity estimation means, When it had a quasistable state detection means to detect an unstable state of operation and an unstable state of operation is detected by the quasistable state detection means, Steering gear of vehicles constituting so that said steering amount characteristic changing means may change the characteristic of said steering amount and/or said transfer characteristic alteration means may change said transfer characteristic.
[Claim 2]Steering gear of the vehicles according to claim 1 constituting so that said steering amount characteristic changing means may increase said steering amount and/or said transfer characteristic alteration means may decrease said transfer characteristic, when an unstable state of operation is detected by said quasistable state detection means.
[Claim 3]Steering gear of the vehicles according to claim 1 or 2 for which said transfer characteristic is characterized by a thing of said steering quantity to said steering amount for which it has at least one in a first order lead element and a first order lag element comparatively.
[Claim 4]Said quasistable state detection means detects a difference of steering quantity detected by said steering quantity detection means, and steering quantity presumed by said steering quantity estimation means, Steering gear of vehicles given in any 1 paragraph of Claim 1 constituting so that a steering entropy value which expresses a quasistable state of operation based on the degree of **** of this difference may be calculated to 3.
[Claim 5]Steering gear of the vehicles according to claim 4 having further a factor which the

characteristic of said steering amount should change according to said steering entropy value, and should carry out multiplication to variation per time of said steering amount.

[Claim 6]Steering gear of the vehicles according to claim 4 or 5 characterized by a thing of said steering quantity to said steering amount constituted so that the temporal change of at least one of said factors might be comparatively carried out to said first order lead element and said first order lag element until said steering entropy value turns into below the 1st value.

[Claim 7]Said steering quantity to said said steering amount comparatively Said first order lead element, Steering gear of the vehicles according to claim 6 constituting said first order lag element and variation per time [at least] in said viscous factor so that it may determine according to a run state of vehicles, running environment, and/or a driver's condition other than said steering entropy value.

[Claim 8]Said factor is changed until the 1st hour passes, or until the value reaches the 2nd value, When said steering entropy value does not turn into said below 1st value as a result of such change, Steering gear of the vehicles according to claim 6 or 7 constituting so that said first order lead element and a first order lag element may be changed until the 2nd and 3rd hours pass, respectively, or until it reaches the 3rd and 4th values, respectively.

[Claim 9]Said first order lead element and a first order lag element are changed until the 2nd and 3rd hours pass, or until it reaches the 3rd and 4th values, respectively, Steering gear of vehicles given in any 1 paragraph of Claim 6 constituting so that a rate of said steering quantity over said steering amount may be changed when said steering entropy value does not turn into said below 1st value as a result of such change to 8.

[Claim 10]Steering gear of the vehicles according to claim 8 or 9 constituting said 1-3rd hours or the 2-4th values so that it may determine according to a run state of vehicles, running environment, and/or a driver's condition.

[Claim 11]Steering gear of the vehicles according to claim 7 or 10 making said run state into a rate of change or the vehicle speed to a steering amount of a yaw rate at the time of vehicle running.

[Claim 12]Steering gear of the vehicles according to claim 7, 10, or 11 making said running environment whether it be dark in the circumference of that it is a time of a rainfall, snowfall, or a fallout, and vehicles.

[Claim 13]Steering gear of vehicles given in any 1 paragraph of Claim 7 making said driver's condition into a driver's heart rate, 10 and 11, or 12.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the steering gear of the vehicles which control the state of vehicles at the time of a driver's steering.
[0002]
[Description of the Prior Art]Conventionally, the steering gear of such vehicles is indicated by JP,H9-58507,A and JP,H11-227491,A.
[0003]The steering quantity to a steering amount is making it change comparatively (a "steering gain" is called henceforth.) in the steering gear of the vehicles indicated by JP,H9-58507,A according to run states, such as the vehicle speed.
[0004]In the steering gear of the vehicles indicated by JP,H11-227491,A, the difference of the steering angle presumed when it is assumed that steering was performed smoothly, and a actual steering angle is calculated, and the steering entropy value is calculated from the degree of **** of distribution of the difference. That this steering entropy value is large means that steering is not smooth. When steering is not smooth, restriction is provided in the contents of a display or instrument mounting.
[0005]
[Problem(s) to be Solved by the Invention]However, since a steering gain becomes high at the time of the low vehicle speed in the case of the steering gear of the vehicles indicated by JP,H9-58507,A, there is a possibility that a driver may sense sense of incongruity, and it becomes difficult to reduce wandering at the time of steering.
[0006]On the other hand, in the case of the steering gear of the vehicles indicated by JP,H11-227491,A, a measure with which a driver does not operate a switch etc. and which usually lowers a steering entropy value positively at the time of a run is not taken, and it becomes difficult to reduce wandering at the time of steering.
[0007]The steering gear of the vehicles according to claim 1 to 12 aims at reducing wandering at the time of a driver's steering easily.

[0008]

[Means for Solving the Problem]A steering amount detection means by which steering gear of the vehicles according to claim 1 detects a steering amount of a steersman stage, A steering amount characteristic changing means which can change the characteristic of said steering amount, and a transfer characteristic alteration means which can change the transfer characteristic of a transmission mechanism which transmits a steering amount of said steersman stage to a steering gear style, A steering quantity estimation means which presumes steering quantity of said steering gear style at the time of assuming that steering was performed smoothly based on said steering amount detected by steering quantity detection means to detect steering quantity of said steering gear style, and said steering amount detection means, Based on steering quantity presumed by steering quantity detected by said steering quantity detection means, and said steering quantity estimation means, When it had a quasistable state detection means to detect an unstable state of operation and an unstable state of operation is detected by the quasistable state detection means, It constituted so that said steering amount characteristic changing means might change the characteristic of said steering amount and/or said transfer characteristic alteration means might change said transfer characteristic.

[0009]When an unstable state of operation was detected by said quasistable state detection means, steering gear of the vehicles according to claim 2 was constituted so that said steering amount characteristic changing means might increase said steering amount and/or said transfer characteristic alteration means might decrease said transfer characteristic.

[0010]Steering gear of the vehicles according to claim 3 is characterized by a thing of said steering quantity [as opposed to said steering amount in said transfer characteristic] for which it has at least one in a first order lead element and a first order lag element comparatively.

[0011]Steering gear of the vehicles according to claim 4 detects a difference of steering quantity from which said quasistable state detection means was detected by said steering quantity detection means, and steering quantity presumed by said steering quantity estimation means, It constituted so that a steering entropy value which expresses a quasistable state of operation based on the degree of **** of this difference might be calculated.

[0012]Steering gear of the vehicles according to claim 5 has further a factor which the characteristic of said steering amount should change according to said steering entropy value, and should carry out multiplication to variation per time of said steering amount.

[0013]Said steering quantity to said steering amount steering gear of the vehicles according to claim 6 comparatively, It constituted so that the temporal change of at least one of said factors might be carried out to said first order lead element and said first order lag element until said steering entropy value turns into below the 1st value.

[0014]Said steering quantity to said said steering amount steering gear of the vehicles according to claim 7 comparatively, It constituted so that variation per time [at least] in said viscous factor might be determined as said first order lead element and said first order lag element according to a run state of vehicles, running environment, and/or a driver's condition other than said steering entropy value.

[0015]Steering gear of the vehicles according to claim 8 changes said factor until the 1st hour passes, or until the value reaches the 2nd value, When said steering entropy value does not turn into said below 1st value as a result of such change, It constituted so that said first order lead element and a first order lag element might be changed until the 2nd and 3rd hours pass, respectively, or until it reaches the 3rd and 4th values, respectively.

[0016]Steering gear of the vehicles according to claim 9 said first order lead element and a first order lag element, It is made to change until the 2nd and 3rd hours pass, or until it reaches the 3rd and 4th values, respectively, When said steering entropy value did not turn into said below 1st value as a result of such change, it constituted so that a rate of said steering quantity over said steering amount might be changed.

[0017]Steering gear of the vehicles according to claim 10 constituted said 1-3rd hours or the 2-4th values so that it might determine according to a run state of vehicles, running environment, and/or a driver's condition.

[0018]Steering gear of the vehicles according to claim 11 made said run state variation or the vehicle speed to time of a yaw rate at the time of vehicle running.

[0019]Steering gear of the vehicles according to claim 12 made said running environment whether it be dark in the circumference of that it is a time of a rainfall, snowfall, or a fallout, and vehicles.

[0020]Steering gear of the vehicles according to claim 13 made said driver's condition a driver's heart rate.

[0021]

[Effect of the Invention]According to the steering gear of the vehicles according to claim 1, when the unstable state of operation is detected by a quasistable state detection means, a steering amount characteristic changing means changes the characteristic of a steering amount, and/or a transfer characteristic alteration means changes said transfer characteristic. Thus, wandering at the time of steering can be reduced by changing the characteristic and/or the transfer characteristic of a steering amount.

[0022]According to the steering gear of the vehicles according to claim 2, when the unstable state of operation is detected by a quasistable state detection means, a steering amount characteristic changing means increases a steering amount, and/or a transfer characteristic alteration means decreases a transfer characteristic. When operation operation is in an unstable state, by increasing a steering amount and/or decreasing a transfer characteristic, wandering at the time of steering can be reduced good.

[0023]According to the steering gear of the vehicles according to claim 3, a transfer characteristic has at least one in the rate of steering quantity over a steering amount, a first order lead element, and a first order lag element. When the characteristic and the transfer characteristic of a steering amount have these rules of thumb, the characteristic and the transfer characteristic of a steering amount can be set up appropriately, and, as a result, wandering at the time of steering can be reduced good.

[0024]According to the steering gear of the vehicles according to claim 4, a quasistable state detection means detects the difference of the steering quantity detected by the steering quantity

detection means, and the steering quantity presumed by the steering quantity estimation means, and calculates the steering entropy value which expresses the quasistable state of operation based on the degree of **** of this difference. With such a steering entropy value, the grade of wandering at the time of steering can be expressed appropriately, and, as a result, wandering at the time of steering can be reduced appropriately.

[0025]According to the steering gear of the vehicles according to claim 5, the characteristic of a steering amount changes according to a steering entropy value, and has further a factor which should be carried out multiplication to the variation per time of a steering amount. By this, a transfer characteristic can be set up still more appropriately and, as a result, wandering at the time of steering can be reduced still better.

[0026]According to the steering gear of the vehicles according to claim 6, the temporal change of at least one of factors is carried out to the rate of steering quantity over a steering amount, a first order lead element, and a first order lag element until a steering entropy value turns into below the 1st value. By this, a transfer characteristic can be set up still more appropriately and, as a result, wandering at the time of steering can be reduced still better.

[0027]According to the steering gear of the vehicles according to claim 7, the steering quantity to a steering amount comparatively, The variation per time [at least] in a viscous factor is determined as a first order lead element and a first order lag element according to the run state of vehicles, running environment, and/or a driver's condition other than a steering entropy value. By this, the run state of vehicles, running environment, and/or the transfer characteristic according to the driver's condition can be determined, and, as a result, wandering at the time of steering can be reduced still better.

[0028]According to the steering gear of the vehicles according to claim 8, a factor is changed until the 1st hour passes, or until the value reaches the 2nd value, When a steering entropy value does not turn into below the 1st value as a result of such change, a first order lead element and a first order lag element are changed until the 2nd and 3rd hours pass, respectively, or until it reaches the 3rd and 4th values, respectively. Control of a steering entropy value is performed good by this, and, as a result, wandering at the time of steering can be reduced still better by it.

[0029]According to the steering gear of the vehicles according to claim 9, a first order lead element and a first order lag element, When it is made to change until the 2nd and 3rd hours pass, or until it reaches the 3rd and 4th values, respectively, and a steering entropy value does not turn into below the 1st value as a result of such change, the rate of steering quantity over a steering amount is changed. Control of a steering entropy value is performed good by this, and, as a result, wandering at the time of steering can be reduced still better by it.

[0030]According to the steering gear of the vehicles according to claim 10, the 1-3rd time or 2-4th values are determined according to the run state of vehicles, running environment, and/or a driver's condition. By this, a steering entropy value can be determined according to the run state of vehicles, running environment, and/or a driver's condition, and, as a result, wandering at the time of steering can be reduced still better.

[0031]According to the steering gear of the vehicles according to claim 11, let a run state be the

rate of change or the vehicle speed to the steering amount of the yaw rate at the time of vehicle running. By this, a run state can be judged appropriately and, as a result, wandering at the time of steering can be reduced still better.

[0032]According to the steering gear of the vehicles according to claim 12, running environment is made whether it to be dark in the circumference of that it is a time of a rainfall, snowfall, or a fallout, and vehicles. By this, running environment can be judged appropriately and, as a result, wandering at the time of steering can be reduced still better.

[0033]According to the steering gear of the vehicles according to claim 13, let a driver's condition be a driver's heart rate. By this, a driver's condition can be judged appropriately and, as a result, wandering at the time of steering can be reduced still better.

[0034]

[Embodiment of the Invention]Hereafter, an embodiment of the invention is described with reference to Drawings. Drawing 1 is a figure showing the embodiment of the steering gear of the vehicles by this invention. In drawing 1, the end of the 1st steering shaft 1 steers the wheels 4a and 4b via the steering links 3a and 3b, respectively by forming the pinion shaft 2a of the rack-and-pinion type steering 2 as a steering gear style, and telling the rotation to rack 2b.

[0035]The other end of the 1st steering shaft 1 performs one end of the 2nd steering shaft 6, mechanical connection, and separation via the electromagnetic clutch 5. The steering wheel 7 as a steersman stage is connected with the other end of the 2nd steering shift 6.

[0036]The steerage reaction force generated with the 2nd drive motor 11 is transmitted to the 1st steering shaft 1 via the gear 10 which the control force generated with the 1st drive motor 9 was transmitted via the gear 8 connected mechanically, and was mechanically connected with the 2nd steering shaft 6. Have the 1st drive motor 9 and the encoder 9a as a steering quantity detection means to detect the angle of rotation theta 1 (steering quantity) of the 1st steering shaft the 2nd drive motor 11, It has the encoder 11a as a steering amount detection means to detect the angle of rotation theta 2 (steering amount) of the 2nd steering shaft. The steering angle sensor 12 as a steering amount detection means to detect the angle of rotation theta 3 (steering amount) of a steering wheel is formed in the 2nd steering shaft 6.

[0037]The detected angle of rotation theta 1, theta 2, and/or theta 3, With the signal W of the windshield wiper switch 14 for detecting the vehicle speed V and running environment from the speed sensor 13 for detecting a run state, and the signal L of the light switch 15. The execution control unit (ECU) 16 as a steering amount characteristic changing means, a transfer characteristic alteration means, a steering quantity estimation means, and a quasistable state detection means is supplied. It is considered as the rotational speed sensor which detects the revolving speed of the front wheel corresponding to [for example] the vehicle speed for the speed sensor 13, or a rear wheel. ECU16 tells the result of having performed control explained after being based on these angle of rotation theta 1, theta 2 and/or theta 3, the vehicle speed V, and the signals L and W to the clutch 5, the 1st drive motor 9, and the 2nd drive motor 11, as a command value, respectively.

[0038]Drawing 2 is a flow chart explaining operation of the embodiment of drawing 1. ECU16 will perform this routine, if the ignition key switch of the vehicles which are not illustrated is set as on

position, and if the ignition switch of vehicles is set as an off position, it will end this routine.

[0039]Target steering angle thetar as steering quantity of the rack-and-pinion type steering 2 at the time of assuming that steering was performed smoothly as a transfer characteristic of a transmission mechanism in this routine is computed, While driving the 1st drive motor 9 so that it may be set to the target steering angle thetar, steerage reaction force is determined as the characteristic of a steering amount, and in order to generate the steerage reaction force, the 2nd drive motor 11 is driven.

[0040]Control step I to which in making these 1st and 2nd motors 9 and 11 drive the characteristic of steerage reaction force is changed in order to change the characteristic of a steering amount, The control step II which adjusts the damping time constant Td as a first order lag element for securing the damping time constant Tf as a first order lead element for raising the response of vehicles, and the stability of vehicles in order to change the transfer characteristic of a transmission mechanism, The control step III into which the steering gain G is made to change in order to change the transfer characteristic of a transmission mechanism, and the control step IV which computes the steering gain G for change of the characteristic of a steering amount and the transfer characteristic of a transmission mechanism to ******** are performed according to the conditions explained later.

[0041]The 1st coefficient K1 relevant to inertia while being proportional to steering angle acceleration d^2theta3-/dt^2 about steerage reaction force in this embodiment, It is determined by the 2nd coefficient K2 as a factor relevant to viscosity, the 3rd coefficient K3 relevant to elasticity while being proportional to the steering angle theta 3, and the 4th coefficient K4 relevant to friction by a direction while being proportional to the steering angle speed dtheta3/dt. That is, it is set to d^2theta3 [K=K1and]/dt^2+K2-dtheta3-/dt+K3 and theta3+K4 when steerage reaction force is set to K.

[0042]In order to reduce wandering at the time of steering in changing the characteristic of steerage reaction force, it is thought effective to enlarge the 2nd coefficient K2 proportional to the steering angle speed dtheta3/dt, and the 2nd coefficient K2 is changed in control step I according to the steering entropy value Hp. The steering entropy value Hp calculates the difference of target steering angle thetar and the steering angle theta 3, and JP,H11-227491,A is asked for it from the degree of **** of distribution of the difference as indicated. Target steering angle thetar is determined by carrying out the multiplication of transfer characteristic G(1+Tf S)/(1+TdS) to the steering angle theta 3, as shown in drawing 3. S is a Laplace operator.

[0043]In changing the characteristic of a steering amount, or the transfer characteristic of a transmission mechanism, the existence of the reduction effect the steering entropy value's Hp and a driver's sense of incongruity is taken into consideration, Control is performed by the priority of control step I, control step II, and the control step III by the priority of change of the factor K2, adjustment of the damping time constants Td and Tf, and change of the steering gain G.

[0044]First, while setting to zero the timer which is not illustrated in Step S1, The initial value of the steering gain reference characteristic ratio G1 used for computing the steering gain G, the target

steering entropy value p1 as the 1st value, the damping time constants Tf and Td, and the 1st - the 4th coefficient K1-K4 is set up, respectively. According to this embodiment, the initial value of the steering gain reference characteristic ratio G1 is set to 1.0, and the initial value of the target steering entropy value p1, the damping time constants Tf and Td, and the 1st - the 4th coefficient K1-K4 is appropriately set up according to a design, respectively.

[0045]subsequently, the steering entropy value Hp -- computing (Step S2) -- a timer is started (Step S3). Subsequently, in order to detect whether the state of operation is unstable, it is judged whether the steering entropy value Hp is larger than the target steering entropy value p1.

[0046]When the steering entropy value Hp is not larger than the target steering entropy value p1, it judges that the state of operation is stable and the control step IV is performed (Step S5). When the steering entropy value Hp is larger than the target steering entropy value p1, it judges that the state of operation is unstable and it is judged whether control step I is performed (Step S6).

[0047]Even if in judging whether control step I is performed the value of the factor K2 reaches the value p2 as the 2nd value until 1st transition time tlim1 as the 1st hour passes or, when the steering entropy value Hp does not become less than target steering entropy value p1, It judges whether the control step II is performed (Step S7), and in being other, it performs control step I (Step S8).

[0048]In judging whether the control step II is performed, Even if the value of the damping time constants Td and Tf reaches the values p3 and p4 as the 3rd and 4th values, respectively until 2nd transition time tlim2 as the 2nd hour passes or, when the steering entropy value Hp does not become less than target steering entropy value p1, It judges whether the control step III is performed (step S9), and in being other, it performs control step I (Step S10).

[0049]When the steering entropy value Hp does not become less than target steering entropy value p1 in judging whether the control step III is performed, the control step III is performed, and in being other, it performs the control step IV (Step S5).

[0050]After performing Step S8, Step S10, or Step S11, the control step IV is performed (Step S12).

[0051]After performing the control step IV by Step S5 or S12, target steering angle thetar is computed by [as it already explained] (Step S13), and the 1st drive motor 9 is driven so that it may be set to the target steering angle thetar (Step S14). Then, as it already explained, the steerage reaction force K is determined (Step S15), in order to generate the steerage reaction force K, the 2nd drive motor 11 is driven (Step S16), and it returns to Step S2.

[0052]Drawing 4 is a figure showing the subroutine of control step I. First, in Step S101, the inclination coefficient A deltak2 to which the coefficient K2 is changed based on the rate of change (henceforth a "yaw rate gain") and running environment over a steering angle of a yaw rate as a run state of vehicles is computed. It sets up to indicate to drawing 5 that such an inclination coefficient stabilizes a driver's operation promptly when the transfer characteristic of a transmission mechanism must not be sensitive. In this case, running environment is made whether it to be dark in the circumference of whether a fluid like rain or a solid like hail is falling, and vehicles. When dark in the circumference of vehicles, namely, when the signal from a light switch is one, When the

fluid or the solid is falling using the characteristic as shown in the straight line L1 (i.e., when the signal from a windshield wiper switch is one), in being other, it uses the characteristic as shown in the straight line L3 using the characteristic as shown in the straight line L2.

[0053]Subsequently, when what carried out the multiplication of the inclination coefficient A deltak2 to the difference of the steering entropy value Hp and the target steering entropy value p1 is made into the increase of stock deltaK2 in Step S102, What computed before or added this increase of stock deltaK2 to the 2nd coefficient K2 of the initial value serves as the 2nd new coefficient K2. That is, it is set to K2=K2+deltaK2. The relation between the difference of the steering entropy value Hp and the target steering entropy value p1 and the inclination coefficient A deltak2 is shown in drawing 6.

[0054]Subsequently, transition time tlim1 is computed in Step S103. As shown in drawing 7, transition time tlim1 with ****** at the time of a yaw rate gain, a rainfall and snowfall, or a fallout. When dark in the circumference of vehicles, namely, when it is set up according to whether it is dark in the circumference of vehicles and the signal from a light switch is one in this case, When the fluid or the solid is falling using the characteristic as shown in the straight line L11 (i.e., when the signal from a windshield wiper switch is one), in being other, it uses the characteristic as shown in the straight line L13 using the characteristic as shown in the straight line L12.

[0055]Subsequently, in Step S104, it is judged whether the measurement value t of the timer which is not illustrated exceeded transition time tlim1. When not exceeding transition time tlim1, it is judged whether the 2nd coefficient K2 is larger than the 2nd value p2 (Step S105). It progresses to Step S105, after resetting to zero the timer which is not illustrated (Step S106) and performing the control step II (Step S107), when exceeding transition time tlim1.

[0056]When the 2nd coefficient K2 does not exceed the 2nd value p2 at Step S105, end and this subroutine when that is not right, This subroutine is ended, after resetting to zero the timer which is not illustrated (Step S108), performing the control step II (Step S109) and setting the 2nd coefficient K2 as the 2nd value p2.

[0057]Drawing 8 is a figure showing the subroutine of the control step II. First, in Step S201, inclination coefficient A deltaTd and AdeltaTf to which the damping time constants Td and Tf are changed based on a yaw rate gain and running environment are computed. These inclination coefficient is also set up as shown in drawing 5.

[0058]Subsequently, when what carried out the multiplication of inclination coefficient A deltaTd and AdeltaTf to the difference of the steering entropy value Hp and the target steering entropy value p1, respectively is made into the increases of stock delta Td and delta Tf in Step S202, What computed before or added these increases-of-stock deltaK2deltaTd and deltaTf to the damping time constants Td and Tf of the initial value, respectively serves as the new damping time constants Td and Tf. That is, it is set to Td =Td+deltaTdTf =Tf+deltaTf. The relation between the difference of the steering entropy value Hp and the target steering entropy value p1 and the damping time constants Td and Tf is shown in drawing 9 and 10, respectively.

[0059]Subsequently, in Step S203, the transition time tlim2 and tlim3 is computed, respectively. The transition time tlim2 and tlim3 is also set up using the relation shown in drawing 7.

[0060]Subsequently, in Step S204, it is judged whether the measurement value t of the timer which is not illustrated exceeded transition time tlim2. When not exceeding transition time tlim2, it is judged whether the damping time constant Td is larger than the 3rd value p3 (Step S205). It progresses to Step S205, after resetting to zero the timer which is not illustrated (Step S206) and performing the control step III (Step S207), when exceeding transition time tlim2.

[0061]It is judged whether when the damping time constant Td did not exceed the 3rd value p3 at Step S205, the measurement value t of the timer which is not illustrated exceeded transition time tlim3 (Step S208), It progresses to Step S208, after resetting to zero the timer which is not illustrated (Step S209), performing the control step III (Step S210) and setting the damping time constant Td as the 3rd value p3, when that is not right.

[0062]In Step S208, when the measurement value t of the timer which is not illustrated does not exceed transition time tlim3 **, it is judged whether the damping time constant Tf is larger than the 4th value p4 (Step S212). It progresses to Step S212, after resetting to zero the timer which is not illustrated (Step S213) and performing the control step III (Step S214), when exceeding transition time tlim3.

[0063]When the damping time constant Td does not exceed the 4th value p4 at Step S205, this subroutine is ended, when that is not right, the timer which is not illustrated is reset to zero (Step S215), the control step III is performed (Step S216), and this subroutine is ended.

[0064]Drawing 11 is a figure showing the subroutine of the control step III. First, in Step S201, the steering gain reference characteristic ratio G1 is computed. This steering gain reference characteristic ratio G1 is set as 1.0, while the steering entropy value Hp does not exceed the target steering entropy value p1, as shown in drawing 12, and if the target steering entropy value p1 is exceeded, it will set up decrease according to several kilogram of inclination charge.

[0065]Subsequently, in Step S202, the standard steering gain G2 for setting up the steering gain G is computed. This standard steering gain G2 is set as a fixed value, while the vehicle speed V does not exceed the predetermined value V1, as shown in drawing 13, and if the predetermined value V1 is exceeded, it will set up decrease exponentially.

[0066]Subsequently, in Step S203, by carrying out the multiplication of the standard steering gain G2 to the steering gain reference characteristic ratio G1, the steering gain G is computed and this subroutine is ended. Therefore, the steering gain G is set to G=G1xG2.

[0067]Drawing 14 is a figure showing the subroutine of the control step IV. First, in Step S301, the standard steering gain G2 is computed like Step S201 of drawing 11. Subsequently, in Step S302, by carrying out the multiplication of the standard steering gain G2 to the steering gain reference characteristic ratio G1, the steering gain G is computed and this subroutine is ended. Since the steering gain reference characteristic ratio G1 is 1.0 in this subroutine, the steering gain G is equivalent to the standard steering gain G2.

[0068]Drawing 15 is a figure showing the control result obtained by performing the flow chart of drawing 2. According to this, after only transition time tlim1 performs control step I, the steering entropy value Hp has become less than the 1st value p1 by performing the control step II.

[0069]According to this embodiment, wandering at the time of steering can be reduced by

changing the characteristic of the steering angle theta 3, and/or the transfer characteristic of a rack-and-pinion type steering.

[0070]This invention is not limited to the above-mentioned embodiment, and many change and modification are possible for it. For example, as a steersman stage, a lever, a hand grip, a pedal, etc. other than a steering wheel can also be used, and steering gear styles other than the thing of a rack PININON type can also be used as a steering gear style. A perfect by wire mechanism the steering input shaft and the steering gear style were mechanically indicated to be, for example to JP,H10-21800,A in this invention not only in the composition which can be connected can also be used.

[0071]Although the above-mentioned inclination coefficient and transition time were changed according to the yaw rate gain, the amount of living bodies can be measured and adjusted as a driver's direct burden value, corresponding to a driver's condition. In this case, as shown in drawing 16 and 17, according to a driver's heart rate, each inclination coefficient and transition time are changed. In drawing 16 and 17, L21 and L31 express the characteristic applied, respectively when dark in the circumference of vehicles, L22 and L32 express the characteristic applied at the time of a rainfall, snowfall, or a fallout, respectively, and L33 and L34 express the characteristic applied when other, respectively. Measurement Division of a heart rate is performed by equipping a steering wheel with a heart rate measuring instrument.

[Translation done.]